

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:

Manfred RENKEL et al.

Application No.: 10/574,660

Group Art Unit: 1793

Filed: May 22, 2006

Examiner: Kuang Y. Lin

APPEAL BRIEF UNDER 37 CFR § 41.37

March 6, 2008

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

With reference to the Examiner's telephone call asking to revise the Ground of Rejection of the Appeal Brief filed on January 24, 2008, the revised appeal brief has been filed. If any fee is required, please charge to Deposit Account No. 11-0219.

REAL PARTY IN INTEREST

The real party in interest is G4T GmbH.

RELATED APPEALS AND INTERFERENCES

Appellants, Appellants' representative, and the Assignee of this application are aware of no other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on, the Board's decision in the pending appeal.

STATUS OF CLAIMS

This is an appeal from the final rejection of claims 13-17 as entered in response to the Final Office Action of September 18, 2007.

Claims 1-12 are in the application of which claims 1-12 are canceled. Accordingly, claims 13-17 are pending.

The rejection of claims 13-17 are appealed and is set forth in their entirety in the Claims Appendix attached hereto.

STATUS OF AMENDMENTS

The amendments to the claims, presented in Appellants' Amendment filed November 13, 2007, have been entered.

SUMMARY OF CLAIMED SUBJECT MATTER

The specification at pages 4-6 and Fig. 1, disclose a tool for production of a cast component and a method for producing the same.

More specifically, claim 13 recites:

a tool for production of a cast component from molten titanium alloy, comprising a casting mold (10), (see specification page 4, lines 5-10);

wherein the casting mold comprises at least first and second layers (14, 15), respectively, the first layer (14) forming a mold wall area that comes into contact with the molten titanium alloy and the second layer (15) forming a backfilling stabilization area for the mold wall area (see specification page 4, lines 12-17);

wherein both the first layer and the second layer (14, 15) consist essentially of yttrium oxide, magnesium oxide and calcium oxide (see specification page 4, lines 19-23); and

wherein the second layer (15), which backfills the first layer, has less yttrium oxide and is more coarsely grained than the first layer (see specification page 4, line 32 - page 5, line 4).

The yttrium oxide and the magnesium oxide prevent an undesired reaction of the nonferrous molten metal of the cast component to be produced (see page 5, lines 31-34). Thus, the deviations in dimension and cracking on the cast component are avoided.

In the invention, the second layer has walls thicker than the first layer (claim 14).

The thin first layer (14) suppresses undesired reactions between the casting mold and the nonferrous molten metal. The second layer (15) gives sufficient mechanical strength to the casting mold and provides same with a high thermal capacity which allows the casting mold to cool slowly. The mechanical strength minimizes distortion from shrinkage and the high thermal capacity causes a micro-plastic ductility of the otherwise brittle material to be cast so that no cracks or breaks appear in the component. (see page 5, lines 9-21)

In addition, a method for production of a casting mold for a cast component from molten titanium alloy according to claim 15, is

disclosed in the specification at page 5, lines 6 - 30, and comprises the steps of:

providing a component wax model which has geometrical dimensions of a precision-casting component to be produced with the casting mold (see specification page 5, lines 6-9);

coating the component wax model with a slurry material consisting essentially of water, yttrium oxide, magnesium oxide and calcium oxide (see specification page 5, lines 9-12);

wherein the slurry material is spread in multiple layers on the component wax model in such a way that the casting mold with at least a two-layer construction is created wherein a first layer of the casting mold forms a mold wall area which comes into contact with the molten titanium alloy, and a second layer of the casting mold forms a stabilization area which backfills the mold wall area (see specification page 5, lines 14-29);

drying and hardening the coating for the casting mold (see specification page 5, line 34 - page 6, line 7); and

removing the component wax model from the casting mold;

wherein the slurry material for formation of the second layer which backfills the first layer has less yttrium oxide and is more coarsely grained than the slurry material for formation of the first layer (see specification page 5, lines 26-29).

In the method of the invention, together with the water of the slurry material, the magnesium oxide causes an exothermal reaction during which the water is vaporized. This significantly reduces the drying time of layers 14, 15 of the casing mold 10. The firing temperature for the casing mold can be reduced from approximately 1400°C to approximately 900°C wherein the casting temperature is also about 900°C. This makes the production of

casting molds quick, simple and inexpensive. (see page 5, line 31 to page 6, line 7)

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

35 U.S.C. § 103(a)

A. Whether claims 13-17 are obvious in view of Japanese Patent Publication No. 60-12,247 ("JP '247") and further in view of European Patent No. 554,198 ("EP '198") and Japanese Patent Publication No. 4-300,047 ("JP '047").

B. Whether claims 13-17 are obvious in view of Japanese Patent Publication No. 4-300,047 ("JP '047").

ARGUMENT

A. Claim 13 is patentable under 35 U.S.C. §103(a)

1. Claim 13 is not obvious over JP '047

Firstly, Appellants respectfully submit that JP '047 does not teach or suggest all of the recited elements of claim 13. Accordingly, JP '047 does not stand on its own to render obvious the casting mold, as recited in claim 13.

Claim 13 recites wherein the first and second layers of the casting mold are made of yttrium oxide, magnesium oxide, and calcium. However, the abstract of JP '047 appears to only disclose wherein the primary coat layer is compounded of refractory powders consisting of one or more of yttria, zirconia, calcia, and magnesia. JP '047 is silent as to the composition of the second layer.

Claim 13 further recites wherein the second layer, "which backfills the first layer, has less yttrium oxide and is more coarsely grained than the first layer."

In the Advisory Action of November 21, 2007, the Patent and Trademark Office (PTO) asserts in page 3 that "in JP '047, the same refractory material for forming the slurry for the first coating layer is used for sprinkling onto the first coating layer to form a second layer." Appellants respectfully disagree and submit that the abstract of JP '047 only states that "refractory grains consisting of one or ≥ 2 kinds among the above-mentioned refractory materials are sprinkled to form a primary coat layer," (emphasis added), and that the back up shell layer consists of the shell mold.

In paragraph 0009 of JP '047, it is explained that "The back up shell layer is formed, according to the manufacturing method of a conventional ceramic shell mold, by using, as refractory materials, mullite, alumina, zircon sand, molten silica and so on, and as a binder, ethylene silicate hydrolysis liquid, or water or non-water solvent type colloidal silica sol."

The back up shell mold used in JP '047 is not the second layer of the invention.

The PTO further asserts in the final Office Action that it is common knowledge that yttria is more expensive than zirconia, calcia and magnesia and thus it would be obvious to use a lesser amount of yttria for forming the second layer. This argument is not tenable.

According to the present technology, cast components made from molten alloy of titanium or aluminum have a poor surface quality and contour accuracy. They must be machined following the casting process. Namely, it is in particular necessary to smooth the surface and correct the contour of such cast components by metal-cutting technique. Because of the extreme hardness of such cast components, the metal-cutting is very expensive.

In fact, the casting tool of the present invention has the essential advantage that the cast components produced by the tool have not to be machined. This advantage results from the extremely high mechanical and chemical stability of the proposed casting tool. The improved mechanical stability results in particular from the specific features of the second layer. The enhanced chemical stability is achieved in accordance with the features of the first layer, by the selection of three oxides, i.e. yttria, calcia and magnesia, for the manufacture of the tool. Further, the resistance against thermal shock can be increased when using for the second layer less yttria and coarsely grained yttria. The prior art does not even suggest the improved casting tool made by the components as recited in the claims. When comparing the cost required for machining of a cast component with the saving of cost encountered with a reduction of the yttria content in the casting tool, it becomes clear that these marginal cost savings would not be a motivation for the skilled person to use for the second layer a lesser amount of yttrium than for the first layer.

The Advisory Action attempts to discount the added benefit of not requiring machining. Appellants respectfully submit, however, that it is only presented to counter the PTO's argument regarding the "obviousness" of reducing manufacturing costs due to a lesser amount of yttrium in the second layer.

Based upon the above, Appellants respectfully submit that nowhere does JP '047 disclose, teach, or suggest wherein the second layer, "which backfills the first layer, has less yttrium oxide and is more coarsely grained than the first layer," as recited in claim 13.

2. Claim 13 is not obvious over JP '247 and further in view of EP '554 and JP '047

JP '247 discloses that a coating layer of a casting mold and an intermediate layer back filling the coating layer may comprise: MgO, Al₂O₃, ZrO₂, HfO₂, Y₂O₃, CaO, La₂O₃, CeO₂, BaO, and SiO₂. Appellants' casting mold differs from that of JP '247 in that claim 13 recites a specific selection of materials that form the casting mode, specifically, a casting mold that "consists essentially of yttrium oxide, magnesium oxide and calcium oxide." JP '247 simply discloses that the coating layer may include various oxides, and do not disclose or suggest the specific combination used in the invention, i.e., yttrium oxide in the first and second layers, as recited in claim 13.

Furthermore, claim 13 recites wherein the casting mold comprises at least first and second layers, "wherein the second layer which backfills the first layer has less yttrium oxide and is more coarsely grained than the first layer." The cited references do not disclose, teach, or suggest at least this feature.

Based upon the specific combination of MgO, Y₂O₃, and CaO for making the first and second layers, as well as by the specific feature wherein the content Y₂O₃ of the second layer is less than that of the first layer and further in view of the relative particle grain size of Y₂O₃ particles of the second layer, the thermal shock properties of the casting mold can be remarkably improved. In addition, the recited composition yields a tool having very good resistance to highly corrosive molten titanium alloys.

Regarding EP '198, Appellants respectfully submit that this reference only appears to disclose a tool for the production of a ferrous metal, i.e. a nickel or cobalt base superalloy, and does not disclose or suggest the features of the invention. Appellants

submit that it is well known in the art that reactive nonferrous molten metal, like a titanium aluminum molten alloy, has a much more aggressive resorption behavior vis-à-vis molding materials. Appellants further submit that a skilled person would not conclude that a casting material suitable for nickel or cobalt base superalloys is also suitable for the production of a cast component from a reactive nonferrous molten metal.

In regards to JP '047, as presented above, Appellants casting mold includes first and second layers made by yttrium oxide, magnesium oxide and calcium, whereas JP '047, on the other hand, only disclosed wherein the primary coat layer may be formed by yttria, calcia and magnesia. The backup shell appears to be made of other material. Furthermore, the grain size used in the second layer is neither disclosed, taught, nor suggested in JP '047.

As presented above, EP '198, JP '247, and JP '047 singularly, or in any allowable combination fail to suggest Appellants' specific composition in forming a casting mold for molten titanium alloys. Furthermore, nowhere does the applied art suggest that selecting materials, such that the second layer has a lower Y_2O_3 content than the first layer, as well as using more coarsely grained Y_2O_3 particles in the second layer, will result in the improvement of the thermal shock properties of a casting mold and their resistance against titanium alloys, as disclosed by the Appellants.

Furthermore, Appellants respectfully submit that the asserted combination of applied references neither disclose nor suggest the desirability of combining such teachings. It is improper to use the claimed invention as an instruction manual to piece together the teachings of the prior art so that the claimed invention is rendered obvious. The PTO appears to use improper hindsight reconstruction

to pick and choose among isolated disclosures. Accordingly, it is respectfully submitted that the combination is improper.

Appellants respectfully submit, therefore, that claim 13 is patentable not only due to the failure of JP '247 in view of EP '198 and JP '047 to disclose, teach or motivate all recited features of the claims, but are also patentable based upon the improper combination of the applied references. Appellants respectfully request reversal of the 103 rejection over all allowable combinations of JP '247, EP '198, and JP '047.

B. Claim 15 is patentable under 35 U.S.C. §103(a)

1. Claim 15 is not obvious over JP '047

Claim 15 is a method claim based upon the casting mold recited in claim 13. Appellants casting mold includes first and second layers made by yttrium oxide, magnesium oxide and calcium. JP '047, on the other hand only disclosed wherein the primary coat layer may be formed by yttria, calcia and magnesia, but the backup shell appears to be made of other material. Furthermore, the grain size used in the second layer is not disclosed in JP '047. Therefore, JP '047 does not disclose or even suggest the features of the invention.

2. Claim 15 is not obvious over JP '247 in view of EP '198 and JP '047

The PTO asserts that JP '247 discloses a method of making an investment mold comprising a face coating layer of extra fine particles and an intermediate layer. The PTO admits that JP '247 fails to disclose the use of yttrium oxide and relies upon EP '198 and JP '024 to remedy the deficiencies of JP '247. Appellants respectfully disagree.

At the outset, Appellants' casting mold differs from that of JP '247 in that claim 15 recites a specific selection of materials that form the casting mode, specifically, a casting mold that "consists essentially of yttrium oxide, magnesium oxide and calcium oxide." JP '247 simply discloses that the coating layer may include various oxides, and do not disclose or suggest the specific combination used in the invention, i.e., yttrium in the first and second layers, as recited in claim 15.

Furthermore, claim 15 recites wherein the casting mold comprises at least first and second layers, "wherein the slurry material for formation of the second layer which backfills the first layer has less yttrium oxide and is more coarsely grained than the slurry material for formation of the first layer." The cited references do not disclose, teach, or suggest at least this feature.

Based upon the specific combination of MgO, Y_2O_3 , and CaO for making the first and second layers, as well as by the specific feature wherein the Y_2O_3 content of the second layer is less than that of the first layer and further in view of the relative particle grain size of Y_2O_3 particles of the second layer, the thermal shock properties of the casting mold can be remarkably improved. In addition, the recited composition yields a tool having very good resistance to highly corrosive molten titanium alloys.

Regarding EP '198, Appellants respectfully submit that this reference only appears to disclose a tool for the production of a ferrous metal, i.e. a nickel or cobalt base superalloy, and does not disclose or suggest the features of the invention. Appellants submit that it is well known in the art that reactive nonferrous molten metal, like a titanium aluminum molten alloy, has a much more aggressive resorption behavior vis-à-vis molding materials.

Appellants further submit that a skilled person would not conclude that a casting material suitable for nickel or cobalt base superalloys is also suitable for the production of a cast component from a reactive nonferrous molten metal.

Furthermore, JP '047 appears to only disclose wherein the primary coat layer may be formed by yttria, calcia and magnesia, and is silent regarding the composition of the backup shell, i.e., the second layer. Furthermore, the grain size used in the second layer is not disclosed in JP '047.

Based upon the above, EP '198, JP '247 and JP '047 singularly, or in any allowable combination do not suggest Appellants' specific composition, in order to form a casting mold for molten titanium alloys, as recited in claim 15. Furthermore, nowhere does the applied art suggest that the second layer has a lower Y_2O_3 content than the first layer. In addition, nowhere does the applied art suggest that using more coarsely grain Y_2O_3 particles in the second layer, will result in the improvement of the thermal shock properties of a casting mold and their resistance against titanium alloys, as disclosed by the Appellants.

The Office Action further asserts that the use of a lesser amount of yttria for forming the subsequent layer is obvious because yttria is more expensive than zirconia. Appellants respectfully disagree.

According to the present technology, cast components made from molten alloy of titanium or aluminum have a poor surface quality and contour accuracy. They must be machined following the casting process. Namely, it is in particular necessary to smoothen the surface and correct the contour of such cast components by metal-cutting technique. Because of the extreme hardness of such cast components, the metal-cutting is very expensive.

In fact, the casting tool of the present invention has the essential advantage that the cast components produced by the tool have not to be machined. This advantage results from the extremely high mechanical and chemical stability of the proposed casting tool. The improved mechanical stability results in particular from the specific features of the second layer. The enhanced chemical stability is achieved in accordance with the features of the first layer, by the selection of three oxides, i.e. yttria, calcia and magnesia, for the manufacture of the tool. Further, the resistance against thermal shock can be increased when using for the second layer less yttria and coarsely grained yttria. The prior art does not even suggest the improved casting tool made by the components as recited in the claims. When comparing the cost required for machining of a cast component with the saving of cost encountered with a reduction of the yttria content in the casting tool, it becomes clear that these marginal cost savings would not be a motivation for the skilled person to use for the second layer a lesser amount of yttrium than for the first layer.

Furthermore, Appellants respectfully submit that the asserted combination of applied references neither disclose nor suggest the desirability of combining such teachings. It is improper to use the claimed invention as an instruction manual to piece together the teachings of the prior art so that the claimed invention is rendered obvious. The PTO appears to use improper hindsight reconstruction to pick and choose among isolated disclosures. Accordingly, it is respectfully submitted that the combination is improper.

Appellants respectfully submit that claim 15 is patentable not only due to the failure of any allowable combination of JP '247, EP '198, and JP '047 to disclose, teach or motivate all recited features of the claims, but are also patentable based upon the

improper combination of the applied references. Appellants respectfully request reversal of the 103 rejection of claim 15 over all allowable combinations of JP '247, EP '198, and JP '047.

Claims 14, 16, and 17 are patentable under 35 U.S.C. §103(a)

Claims 14, 16, and 17 depend variously from claims 13 and 15, and are likewise patentable over JP '047 by itself, or alternatively over JP '247 in view of EP '198 and JP '047, at least based upon their dependence on an allowable base claim, as well as for the additional features they recite. Accordingly, reversal of this rejection is respectfully requested.

CONCLUSION

Accordingly, Appellants respectfully submit that the rejection of claims 13-17 are in error, and request that the final rejection be reversed.

Respectfully submitted,

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CLAIMS APPENDIX

13. A tool for production of a cast component from molten titanium alloy, comprising a casting mold,

wherein the casting mold comprises at least first and second layers, the first layer forming a mold wall area that comes into contact with the molten titanium alloy and the second layer forming a backfilling stabilization area for the mold wall area;

wherein both the first layer and the second layer consist essentially of yttrium oxide, magnesium oxide and calcium oxide; and

wherein the second layer, which backfills the first layer, has less yttrium oxide and is more coarsely grained than the first layer.

14. A tool as defined in claim 13, wherein the second layer has walls thicker than the first layer.

15. A method for production of a casting mold for a cast component from molten titanium alloy, comprising the steps of:

providing a component wax model which has geometrical dimensions of a precision-casting component to be produced with the casting mold,

coating the component wax model with a slurry material consisting essentially of water, yttrium oxide, magnesium oxide and calcium oxide, wherein the slurry material is spread in multiple layers on the component wax model in such a way that the casting mold with at least a two-layer construction is created wherein a first layer of the casting mold forms a mold wall area which comes into contact with the molten titanium alloy, and a second layer of

the casting mold forms a stabilization area which backfills the mold wall area,

drying and hardening the coating for the casting mold, and removing the component wax model from the casting mold,

wherein the slurry material for formation of the second layer which backfills the first layer has less yttrium oxide and is more coarsely grained than the slurry material for formation of the first layer.

16. A method for production of a cast component from a molten titanium alloy, comprising the steps of:

providing the casting mold as defined in claim 15,

filling the nonferrous molten metal into the casting mold,

solidifying the molten titanium alloy in the casting mold, and removing the cast component from the casting mold.

17. The method as defined in claim 15, wherein a titanium aluminum molten alloy is filled into the casting mold to produce a gas turbine component.

EVIDENCE APPENDIX

No copies of evidence are appended hereto.

RELATED PROCEEDINGS APPENDIX

No copies of decisions are appended hereto.